SCREEN GRAPHICS PRODUCTION

INTRODUCTION

We define **SCREEN GRAPHICS** as a computer generated still picture or animation, which appears on a computer screen, or a video monitor, in a playback situation on a motion picture set.

Screen graphics may be generated directly from a computer display synchronized with the motion picture camera on the set, or the graphics may be pre-recorded on video tape and played back from video on the set. We will first discuss the video playback aspects of screen graphics, then the direct computer methods.

For a computer image to be properly generated for Video Playback, certain specific requirements must be met. This document is intended to outline those requirements, as well as provide a basic background in the video technology that underlies those requirements.

VIDEO STANDARDS

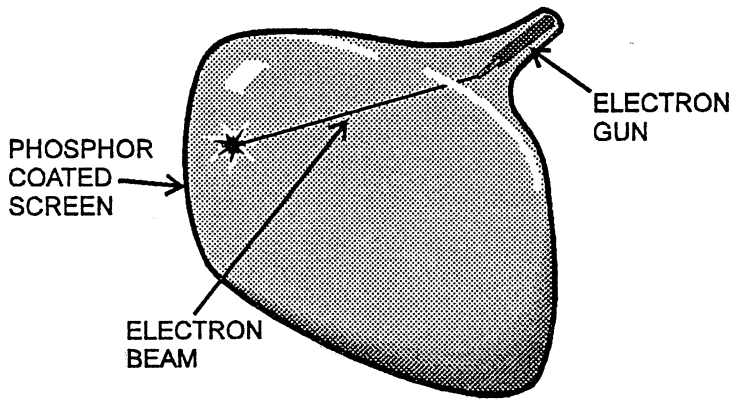
There are two separate video systems commonly used at Video Image.

COMPONENT. The component system comes in several different varieties. The one most often used at Video Image is Red, Green, Blue, and Sync (RGBS). The red, green, and blue signals determine the brightness of their respective colors, and the sync signal determines *where* on the screen the colors exist. This is the system used in the SGIs and the Macs. Component is very high quality, but is very awkward to deal with outside the computer.

COMPOSITE. By heavily processing the RGBS signals in a color encoder, one single, complex video signal may be produced with most of the information in the original RGBS picture. This composite signal, even though quite a bit lower in quality than the original RGBS, has certain attractions. It travels down a single wire, it can be recorded on a video tape machine, and it can be broadcast. This is the system used in the BetaCam edit room and much of Video Village.

The most common display medium for video is the **CATHODE RAY TUBE**, or CRT. (see diagram below) An electron beam is directed across the face of the tube, scanning from left to right, top to bottom, much like one reads a book. The beam strikes phosphors which are on the face of the CRT, causing them to glow. The beam varies in intensity in direct relation to the voltage of the video signal. Once the beam reaches the bottom right corner of the tube, it is turned off, and **RETRACES** back to the top left corner of the CRT.

CATHODE RAY TUBE



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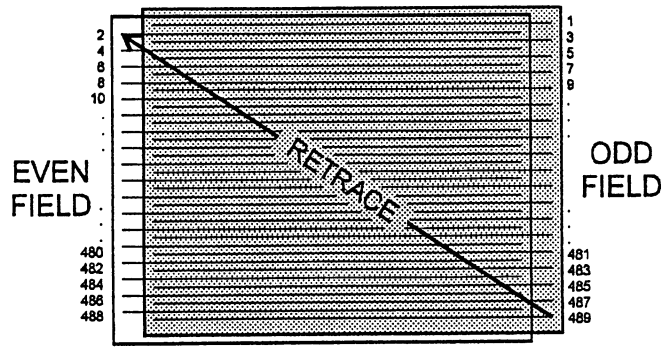
NTSC

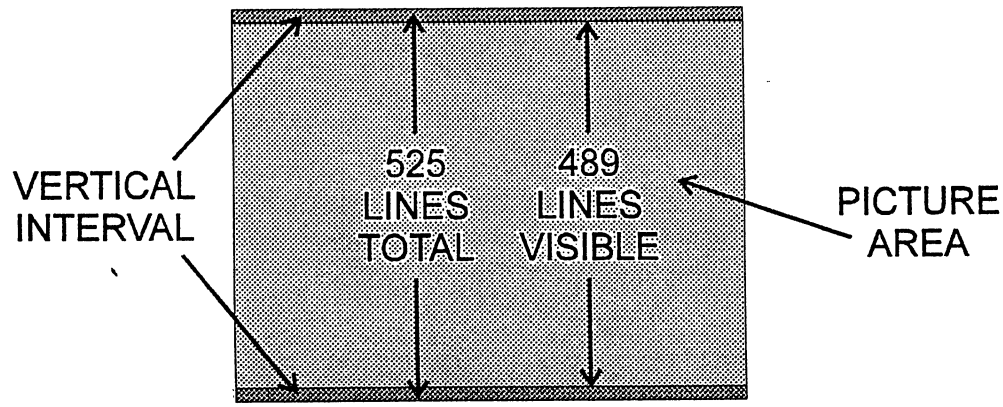
NTSC(National Television System Committee) is the composite color video standard used in the United States. It is used by Video Image for playback purposes, for synchronizing with motion picture cameras shooting at 30 frames-per-second (FPS). Motion picture film is shot at 30FPS for many television commercials, and other film productions that may only be seen in a video form, such as music videos and some episodic television production. NTSC has the following characteristics:

INTERLACED SCAN - Each video **FRAME** consists of two video **FIELDS** (see diagram below). The first field is a display of all the odd scan lines, after which a retrace occurs, and then the second field is scanned, which displays all the even scan lines. This process is repeated thirty times each second. The interlaced scan method was adopted to reduce flicker of the video display.



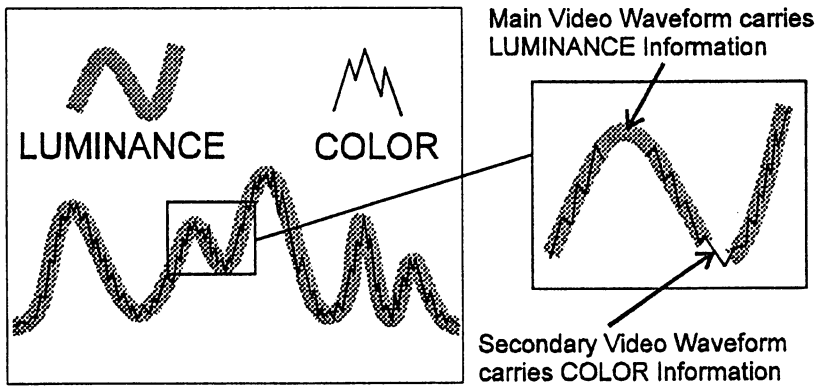
FRAME RATE - 30 frames per second, which equals 60 fields per second.

NUMBER of HORIZONTAL SCAN LINES - 525 lines, which encompases 489 lines of image information. The remaining lines are called the vertical interval, which contain timing information for the video signal, as well as optional time code information, closed caption information, videotex, etc.



COMPOSITE VIDEO SIGNAL - NTSC was originally adopted to maintain compatibility of the color television signal with the original black and white signal. The color information is carried on a second waveform, or subcarrier, which is "pasted" atop the main video waveform, which carries the luminance information (see diagram below). Black and white television displays the luminance signal only, color television displays both the luminance and the color signals.

WAVEFORM REPRESENTATION OF A SINGLE SCAN LINE:



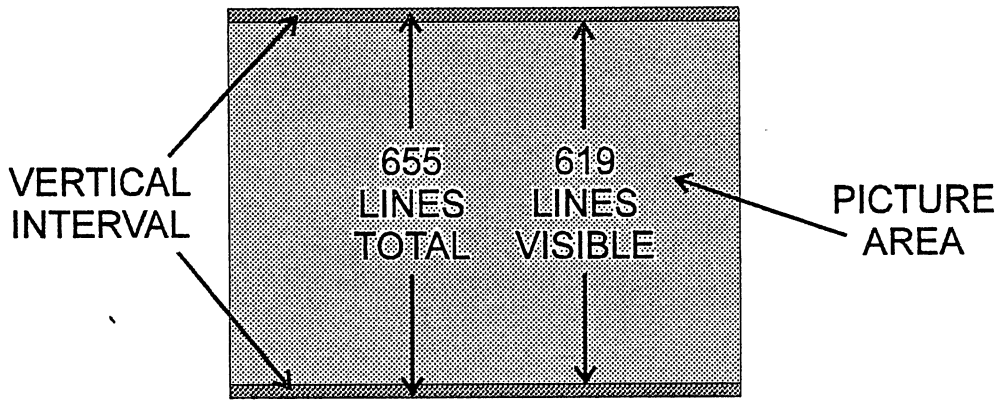
655 Line Video

655 LINE VIDEO is a variant of NTSC, and is the video standard developed and used by Video Image for playback purposes, when synchronizing with motion picture cameras shooting at 24 FPS, the standard frame rate for motion picture production. It has the following characteristics:

INTERLACED SCAN - identical to NTSC.

FRAME RATE - 24 frames per second, which equals 48 fields per second.

NUMBER of HORIZONTAL SCAN LINES - 655 lines, which consists of 619 lines of image information, with the remaining lines serving the same vertical interval functions as in NTSC.



COMPOSITE VIDEO SIGNAL - identical to NTSC.

PRODUCTION GUIDELINES

The most common production method is to generate a video animation from the computer at the standard 30 frames per second rate. This is converted by our video department to our 24 frame per second format, and recorded on 3/4" Umatic videocasettes. These tapes are then played back on the set at 24 FPS, in sync with the movie camera.

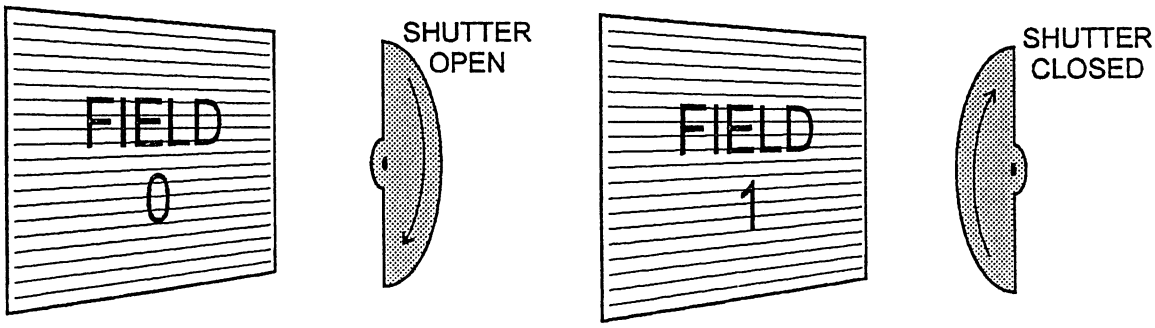
When producing a screen graphic for eventual video tape playback at 24 FPS, certain guidelines must be followed. They include considerations for line width, text size, color information, and scene length.

Line Width

Both 30 and 24 FPS video use an interlaced scan method. When a video display is synchronized with the motion picture camera, the camera is synchronized so it photographs only one field of video from each video frame, either the odd or the even. To understand why this is true, we should familiarize ourselves with the operation of a motion picture camera.

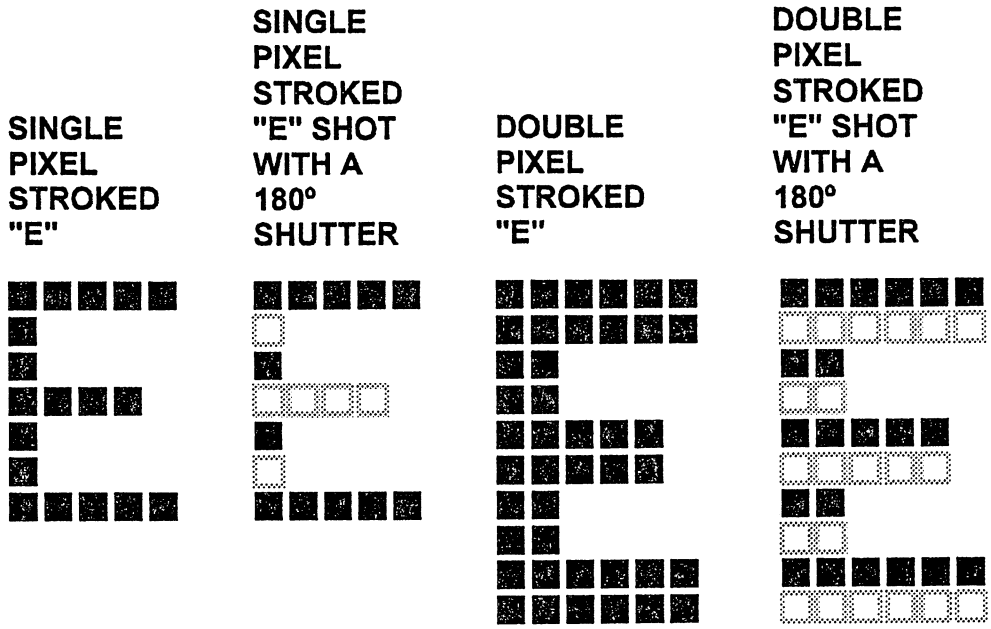
The motion picture camera is adjusted for a video shoot by setting the shutter at 180 degrees. The shutter rotates once for each frame of film exposed. While the camera is running, the shutter is closed while the film is being advanced to an unexposed frame, and it is locked down on registration pins. This takes 1/48th of a second. Next, the shutter opens, and the frame is exposed for 1/48th of a second. This process is repeated 24 times a second, as long as the camera is running.

When photographing a video monitor on which a 24 frame video image is displayed, the camera's shutter is open when one field is being displayed, and closed when the next field is displayed. This means the camera only sees half of the scan lines, or picture information, that is actually on the screen. Each time it is turned on, the movie camera will synchronize with either the odd or the even field, completely by chance.

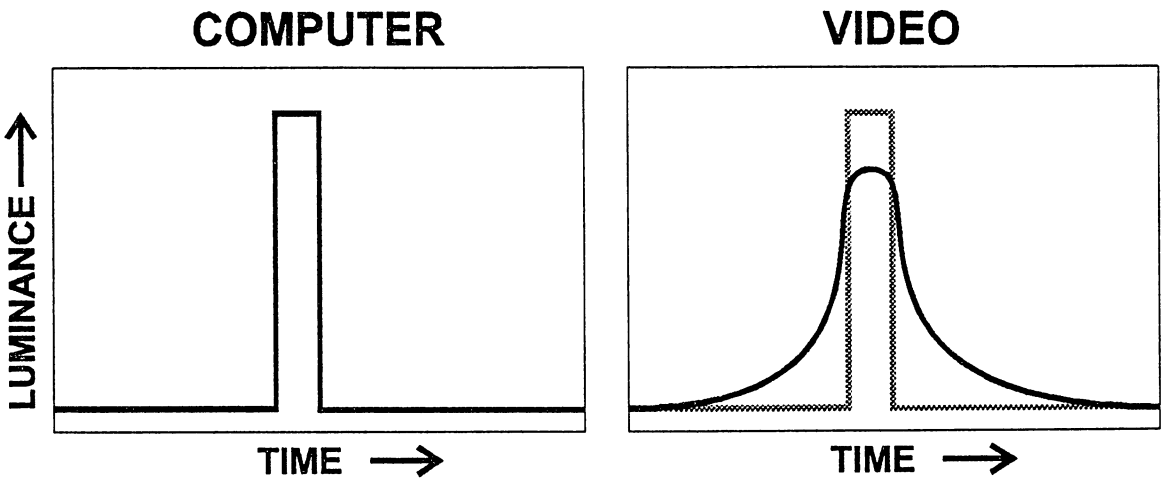


What this means to the screen graphics designer is that if a *horizontal* line of a single pixel in width is used, it has a fifty-fifty chance of not being photographed by the camera. This is

particularly evident when using fonts which are made up of single lines. The diagram below shows the effect of dropping every other line on two forms of the letter "E", one which has single pixel strokes, and another which has double pixel strokes. To ensure all lines are displayed, we design all our graphics with horizontal line widths of at least 2 pixels. We also do the same for vertical lines, but for a different reason.


SINGLE PIXEL STROKED "E"
SINGLE PIXEL STROKED "E" SHOT WITH A 180° SHUTTER
DOUBLE PIXEL STROKED "E"
DOUBLE PIXEL STROKED "E" SHOT WITH A 180° SHUTTER

Vertical lines, and all small details in general, are subject to a degree of degradation when converted from a digital format to a composite video signal. What you see on your computer screen is by no means what you will get when you record your imagery on video disk or video tape! Small, high contrast details, especially small text and graphics, require a large change in the video signal at their edges. Computers were designed to handle small graphics, NTSC was not. Since a computer works with digital data and high resolution displays, those small details are not a problem to display, but when we convert them to the analog world of composite video, problems arise. Consider the display of a single vertical line. On the computer screen, the waveform generating the display would be nearly perfectly straight and square, as shown below. A video recording of the same image would show a waveform that would be rounded and stunted as shown below, since the frequency response , or resolution, of the video system is not wide enough to accommodate such fine details. **Therefore, vertical, as well as horizontal details are drawn with least 2 pixels wide for good looking displays in the video world.**



UltraScan & Direct Computer Playback

There are three exceptions to all this doubling of pixels:

1. When graphics are displayed using our **UltraScan** process, the composite video is converted to a computer-like signal, and the monitor used for display is scanning every line of picture information in 1/48th of a second. Therefore, the movie camera sees *all* the visible scan lines for each exposed frame, instead of only half of them. Two pixel wide details are not required in this situation.

2. We may use a computer on the set to display screen graphics, bypassing the video recording step altogether. In this case, the display is also scanning the entire image in 1/48th of a second, so we can display single pixel details here as well. These set-ups, which consist of both special hardware and software, are known as RTVGA, for IBM compatible computers, and RTMAC for MacIntosh computers.

3. When certain Liquid Crystal Display devices are being filmed, like a laptop computer, or LCD projector. Many of these devices do not require synchronization with the movie camera, since their display does not decay between refreshes as a CRT does. Single pixel details will also display properly on these devices.

It is often impossible to make a determination as to the final display set-up when one is designing a screen graphic. Therefore, it is always recommended to err on the conservative side, and use double pixel widths as a rule.

High Frequency Information

Like small, one pixel details, high frequency information in an image may take on an unexpected appearance when photographed as a screen graphic by a movie camera. Think of a pattern of alternating black and gray horizontal lines. If the lines that make up this pattern are a single pixel in size, thè pattern will either appear as all gray or all black, depending on what field the camera syncs with. One pixel size vertical stripes will interfere with the NTSC color information, causing distorted, or unintended, colors.

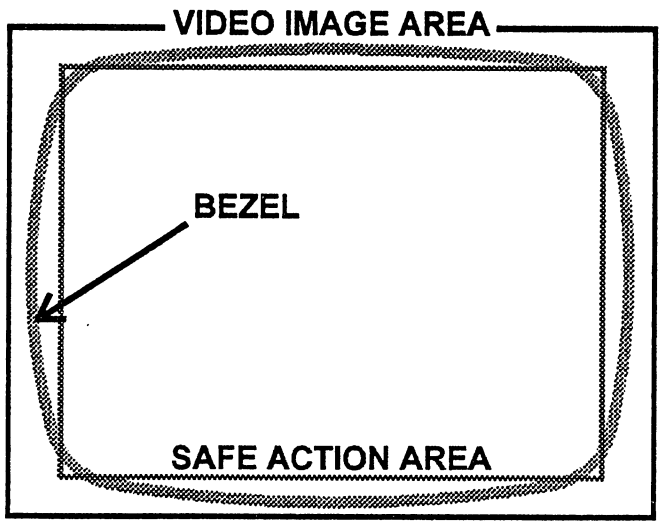
Color

Most computer graphics are designed as 24 bit RGB images. There are certain colors in these images that are "illegal" NTSC colors, colors that cannot be accomodated by an NTSC system. Usually they are the brighter shades of certain fully saturated colors. Many programs, such as PhotoShop, have filters that can filter the colors in an image so that they fall within the legal limits of NTSC. Make certain you make use of those tools as you design your imagery. If in doubt, consult with the video department for an evaluation of the colors you are designing with.

In addition to illegal colors, the composite system used by NTSC and 24 Frame Video has a difficult time dealing with saturated red. This color range tends to become particularly blurred and smeary during playback. Avoid using text or fine details colored in saturated red hues. If the chroma, or intensity of the color is reduced, or if it is taken toward orange, much of this problem will be eliminated.

Video Safe Area

Although all computers display the entire working area of the screen, a video display usually is set up with a portion of the display hidden behind the frame, or bezel, which surrounds the screen. Therefore we design a graphic which is intended for video playback with an amount of bleed area, and keep the important information with in the "TV SAFE ACTION AREA". All computers at Video Image have a standard image showing the TV safe area for your reference, a form of which is shown below. If yours is missing, or you have any questions regarding TV safe, contact the video department or your graphics supervisor.



Standards for Layoff of Video Animations

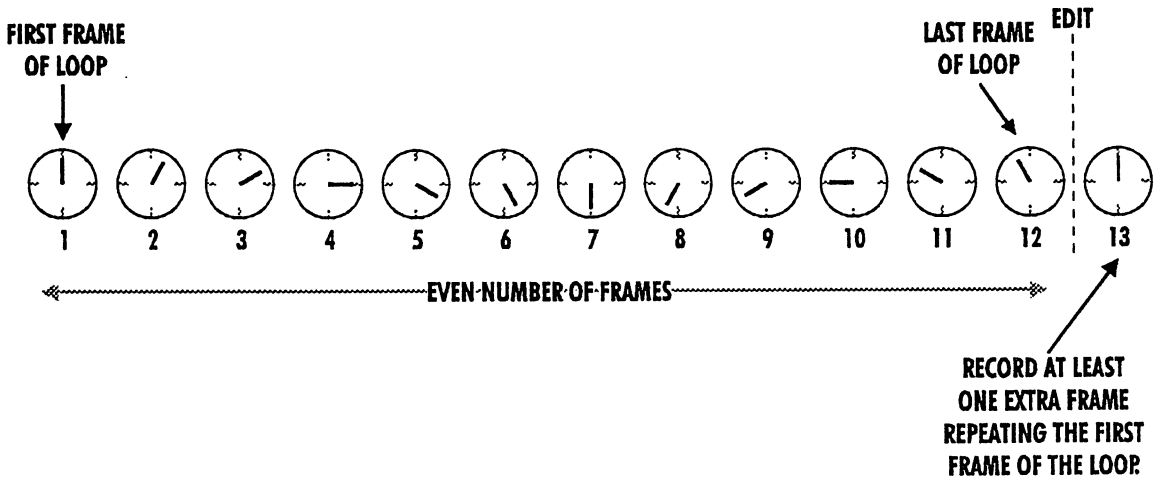
Most screen graphics are recorded, or laid off, as a series of animating single frame images, to one of our Sony Laser Disk Recorders. We use the following format for scene layoff.

1. 1 frame of black
2. 1 frame of slate, using our standard slate image which contains standard color bar and gray scale information.
3. 1 frame of black
4. The animation scene.

Building Loops

We often use our BetaCam editing system to loop or match edit certain animated sequences that have been laid off to video disk. Some loops do not require critical matching of the image at the edit point, such as when a screen wipes blank or cuts to a completely new image. Other loops require critical matching of the image at the cut point of the loop, as in a rotating Earth, or a radar sweep.

When critical matching is required, the scene to be looped must be an even number of frames long. Second, at least one frame must be laid off at the end of the loop, which duplicates the first frame of the loop. And lastly, each piece of material must be laid off consecutively on the same disk, and the same recorder. A sequence laid off on a different disk, a different LVR machine, or on a different day may not match cut with the original. The diagram below shows the layout of a proper animation loop, a 12 frame animation of a indicator rotating around a dial.



Remember every element of your animation must loop! If you have an animation with simultaneous blinking, panning, and rotating actions, all these actions must gracefully match up at the loop edit point. If you design a complex animation loop and it turns out to be an odd number of frames, lay it off twice, with no slate or black frames inbetween. If it is layed off twice this way, the result will be an even number of frames, which can be sucessfully looped.

General Guidelines

Scene Set-up

Each production has a production number, which is used thoughout the company to keep track of relevant data on the production. Know the production number for your current project, and include it in the slate information. Production numbers can be obtained from your production supervisor.

Each production consists of one or more scenes. Identification codes for these scenes begin with an abbreviation for the show, e.g. CT for Crimson Tide, a period, and a number identifying the scene, which usually starts with one and increments up to the total number of scenes in the production. The scene I.D. is another piece of information that should be attached to directories, file folders, and file names for easy identification. Scene I.D. codes can be obtained from the person supervising graphics on your production.

Organize your work. Set up a directory structure where each scene is a folder, or sub-directory under the main folder, which would have the name of the production.

Keep notes and documents in a physical manilla folder for each scene.

Document your work. There are provisions in most programs, whether they are Unix scripts, GRASP program scripts, or MacroMedia Director scripts, for comments and documentation. Make it easy for another person to pick up work on your projects, should it become necessary.

Back Up Your Data

Be sure to back up your data regularly. Hard disks do crash, and people make mistaken deletions, so be certain that you are protected against losing your work. Non-replaceable files like scripts and source images should be backed up daily. Replaceable data such as quick time movies and animation image files can be backed up as needed. Always weigh the time it took to create the data versus the time required to back it up and make it safe.

Use separate disks or data tapes to logically divide up your work, rather than trying to completely fill up a tape or disk with unrelated data.

Useful Information

MacIntosh Frame Buffer Dimensions	640 pixels wide by 480 pixels high
MacIntosh Video Action Safe Area	550 pixels wide by 412 pixels high
SGI Video Framer Dimensions	646 pixels wide by 484 pixels high
SGI Video Framer Safe Action Area	555 pixels wide by 415 pixels high
D-1 Abekas Dimensions (non-square pixels)	720 pixels wide by 484 pixels high
Video Aspect Ratio	1.33 to 1.0

Glossary

655 Line Video - A variant of NTSC video standard, developed and used by Video Image for the playback of video which can be synchronized with motion picture cameras operating at 24 FPS.

Abekas - A manufacturer of video equipment, and in particular, its models of digital disk video recorders.

Bezel - The part of a television reciever or monitor which forms a physical frame around the face of the picture tube.

Cathode Ray Tube - A video display device in which an electron beam scans an image onto the front surface of the tube, illuminating phosphors on that surface.

Closed Captioning - A method of embedding text, usually corresponding the dialogue of a video program, in the vetical interval of a video signal.

Component - A type of video transmission, where the color picture information is transmitted separately as two or more signals.

Composite - A type of video transmission, where the color, the luminance, and the synchronization information are combined in a single signal.

D-1 - A video format in which the video information is stored and processed as digital data.

FPS - Frames-per-second.

Field - In interlaced video, the amount of signal information representing the scan of every other line of the video display. In NTSC video, a video frame is made up of two consecutive fields.

Frame - In film, a single image, one of multiple images sequentially recorded in time on a strip of celluloid. In video, the amount of signal information representing one complete scan of the video display.

Interlaced Scan - A method of scanning an image onto a video display. An electron beam first scans the odd lines of the image onto the display. The beam turns off, and retraces back to one line below its original starting point. Then the beam scans the even lines of the image.

LVR - Laser Video Recorder. A device which records video onto a laser disk.

NTSC - National Television System Committee. The video standard used in the United States.
Pixel - An acronym for PICTURE ELEMENT. The smallest independent element of a computer generated image.

Non-Interlaced Scan - A method of scanning an image onto a video display, where the every line of the image is scanned on in a single pass.

RGB or RGBS - A type of component video, where the red, green, blue, and synchronization information of the color video image are transmitted separately.

Raster - The array of pixels making up a computer display.

SGI - Silicon Graphics Inc. A brand of computers known for advanced graphics capabilities.

Safe Action Area - A standard area which has been determined will not be cropped by the bezels of most television displays.

Screen Graphics - A computer generated graphic still image, or animation, which appears on a computer screen, or a video monitor, in a video playback situation on a motion picture set.

Time Code - A method of embedding time information, stored a digital signal, either on an audio track, or in the vertical interval of a video signal.

UltraScan - A process developed by Video Image in which an interlaced video signal is converted into a non-interlaced signal.

Video Playback - In motion picture production, the process of displaying a video image on a movie set which is photographed by the live action movie camera.

Videotex - A method of embedding text and simple graphic imagery in the vertical interval of a video signal.